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ABSTRACT

This report examines and summarizes the needs in mathematics of the Fresno City school system. The study is one in a series of needs assessment reports for PROJECT DESIGN, an ESEA Title III project administered by the Fresno City Unified School District. Theoretical concepts, rather than computational drill, would be emphasized in the proposed mathematics programs. To offset any decline in computational skills, the new program plans to maintain the skill level, yet find time to introduce the new concepts of modern mathematics. The experimental design of this study tabulates a matrix of school system needs. The following needs are summarized: (1) Societal standards, (2) assessment data, (3) strengths and weaknesses, (4) learner needs, (5) instructional needs, (6) administrative and district needs, and (7) a general category of needs. In addition, 37 suggested solutions and 16 major conclusions are contained at the end of the report. (LN)

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EDUCATIONAL NEEDS

12. MATHEMATICS

FRESNO, 1968

EA 002 930

FRESNO CITY UNIFIED SCHOOL DISTRICT

1968

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FOREWORD

PROJECT DESIGN (Inter-Agency Planning for Urban Educational Needs) was organized as a two-year project to develop a comprehensive long-range master plan of education for the Fresno City Unified School District in California.

This project was conceived by school leadership to bring under one umbrella current major problems of the schools, the relationship of the schools to the broader community, the impact of educational change now occurring throughout the nation, and a fresh view of the educational needs, goals and aspirations of our youth and adults. The ultimate purpose of the project is to weld into an integrated plan the best use of available resources to meet the totality of current and projected needs according to their rational priorities.

The United States Office of Education funded the proposal as an exemplary Title III project, recognizing the urgency for developing better planning processes for urban school systems. The first year of this project was organized to assess current and projected educational needs in the urban area served by the Fresno City Schools. Planning procedures will be carried out in the second project year.

A major dimension of the Needs Assessment is an analysis of educational and urban factors by a Task Force of specialists. This report is one of the Task Force Needs Assessment publication series. See the next page for the complete list of project Needs Assessment publications.

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12. MATHEMATICS

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INITIAL CHARGE

The purpose of this report is to examine and to summarize the needs in mathematics education of the Fresno Unified School District. These needs are in terms of progress towards a set of standards in mathematics composed of the revised Strands Report, as modified and extended to secondary levels by the author.

The report concentrates on future district needs, with emphasis on the period 1968-1975. For this reason, the bad is mentioned more often than the good. What may be sufficient now may be inadequate when compared with what is needed five years from now. The report suggests directions for improvement, rather than mere criticism for things not done in the past. It is my general opinion that the willingness of the school district to make this study shows they are a good district. It is my sincere hope that the ideas presented here can be used.

EXPERIMENTAL DESIGN

Information for this report was obtained by visits to 85 mathematics classrooms in 12 Fresno schools. These visits were supplemented by interviews with teachers and with district personnel, also by the examination of various materials prepared by teachers, the district, and by the Project Design staff.

MAJOR CONCLUSIONS

This section contains a list of major general needs found as a result of the survey of mathematics education in Fresno. The general needs are each followed by a list of numbers referring to specific needs from the Needs Classification Matrix found later in this report.

A. The need exists for a greater understanding and use of modern teaching methods in connection with modern mathematics.

   3a, 4a, 4b, 5a''', 6a, 6b, 7a, 8a, 9a, 9b, 9a', 10a, 43 43a, 43b, 50, 50a, 50b, 63, 63a, 77, 77a, 77b, 97, 97a, 106, 106a, 107, 107a, 107b, 108, 108a, 108b, 109, 109a, 109b, 110, 110a, 110b, 111, 111a, 112, 112a

B. Teachers of minority groups need additional training and information before they begin teaching these classes.

   5a''', 5b''''

C. The entire area of mathematics for terminal students in the secondary schools needs to be analyzed carefully to see if some improvements can be made.

23, 23a, 23b, 59, 59a', 72, 72a, 84a, 84b

D. There is a great need for a district testing program, including the use of both diagnostic and standardized tests, that will be of real use to both the student and the teacher.

5, 5a', 5a'', 5b'', 5b''', 20, 20a, 20b, 22, 22a, 22b, 23, 23a, 23b, 44, 44a, 49, 49a, 49b, 84b, 104, 104a

E. The district needs to systematically explore how small calculator-computers can be used in a more uniform way throughout the district as an integral part of the mathematics program.

59, 59a, 59a', 59b, 59b', 59b'', 96, 96a, 96b

F. Teacher recruiting needs to be evaluated in terms of how it can provide teachers who really understand both the content and the philosophy of modern mathematics.

62b'', 83b

G. The district needs to prepare for the 1970 mathematics adoption for grades 1-8, prior to the time the books are actually put into use.

2b, 4a, 6a, 7a, 28, 28a, 35, 35a, 38a, 38a, 40, 40a, 42, 42a, 42b, 43, 43a, 43b, 50, 50a, 50b, 51, 51a, 55b, 57b, 71, 71a, 71b, 73, 73a, 73b

H. The relationship between the reading program and student progress in mathematics needs to be explored more carefully.

89, 89a, 89b, 89c

I. Each mathematics student needs to be involved in mathematics as a participative act, not just as an observer.

4, 6, 9, 32, 32a, 32b, 35, 35a, 37, 37a, 43, 43a, 43b, 47, 47a, 58, 58a, 58a', 58b, 59, 59a', 59b', 63, 63a, 85, 85a, 95, 95a, 96, 96a, 96b, 97, 97a, 111, 111a, 112, 112a

J. There is a great need to find and to use more real applied problems that are meaningful to pupils.

16, 16a, 33, 33a, 33b, 45, 45a, 52, 52a, 52b, 53, 54, 54a, 56, 57, 57a, 57b, 57b', 58, 58a, 58b, 59, 59a' 63c, 70, 71a, 95, 95a, 96, 96a, 96b, 96c, 100, 100a, 100b

K. The pupils need more guidance, often prior to the ninth grade, on employment prospects and the mathematics courses needed to qualify for various jobs.

59b''

L. Audio-visual materials need to be used wisely to accomplish some specific purposes, and there is a need to check on the frequency of use of district audio visual materials in mathematics.

18, 18a, 18b, 25, 25a, 33, 33a, 33b, 35b, 37, 37a, 37b, 57b', 85, 85a, 85b

M. The Fresno district needs to be aware of trends in state testing in mathematics so that pupils can be prepared adequately.

11, 11a, 12, 32, 32a, 32b, 38, 38a, 48, 48a

N. Information about promising practices developed by one teacher within the district needs to be distributed to many teachers.

58b, 93b, 100b

O. The fact that there is less emphasis on academic mathematics in schools with higher ratios of minority students needs to be considered for its future implications.

98, 98a, 98b

P. There is a need to establish minimum requirements or standards for all students at each grade level in mathematics.

1, 1a, 1b, 5, 5a, 5b, 7, 7a, 5a', 5a'', 5a''', 5a'''', 5b'''', 11b, 16, 20, 20a, 20b, 22, 22a, 22b, 23, 23a, 23b, 26, 26a, 27, 27a, 31, 31a, 32, 32a, 32b, 34, 34a, 35, 35a, 39b, 40, 40a, 44, 44a, 48, 48a, 49, 49a, 49b, 62a', 62b, 69b, 72, 72a, 74, 74b, 83a, 84, 98b

Q. Every student needs to understand the concept of various sets of numbers.

2, 2a, 2b, 3, 13, 13a, 14, 14a, 15, 16, 18, 18a, 18b, 19, 19a, 24, 24a, 25, 25a, 26, 26a, 27, 27a, 28, 28a, 29, 30, 31, 31a, 65, 65a, 65b, 66, 66a

R. There needs to be more involvement of parents and the community in the responsibility for the mathematics program.

1c, 1c', 4c, 54c, 63c, 67c, 89c, 96c, 108c

S. Teachers need to know the appropriate material of modern mathematics thoroughly.

2a, 2b, 9a'', 11a, 12a, 17a, 19a, 21a, 21b, 28a, 29, 30, 31, 31a, 36, 36a, 36b, 39, 39a, 40, 40a, 41, 41a, 41b, 42, 42a, 42b, 46a, 47, 47a, 51, 51a, 55, 55a, 55b, 61, 61a, 62b'', 63, 63a, 64, 64a, 65b, 67b, 71a, 71b, 73 73a, 73b, 76b, 78b, 82b

T. More emphasis on oral work and on estimation needs to be a part of a modern program.

8, 8a, 87, 87a, 87a'

U. As much as possible, pupils need to understand the "why" of all the mathematics they undertake.

10, 10a, 11, 11a, 11b, 12, 12a, 17, 17a, 17b, 21, 21a, 21b, 67, 67a, 68, 68a, 69, 69a, 69b

V. A strand of both informal and formal geometry that will progress through all grade levels needs to be developed.

32, 32a, 32b, 33, 33a, 33b, 34, 34a, 35, 35a, 35b, 36, 36a, 36b, 36b', 37, 37a, 37b, 38, 38a, 39, 39a, 39b, 40, 40a, 41, 41a, 41b, 42, 42a, 42b

W. There is the need to develop a modern strand of measurement that will progress through all grade levels.

43, 43a, 43b, 44, 44a, 45, 45a, 46, 46a, 47, 47a, 48, 48a, 49, 49a, 49b, 50, 50a, 50b, 55, 55a, 55b

X. The district needs to develop a strand of probability and statistics that will begin at least as low as grade 6 and extend upward through all grade levels.

60, 60a, 61, 61a, 62, 62a, 62a', 62b, 62b', 62b'', 63, 63a, 63c, 64, 64a

Y. There is the need to develop a modern strand of logic in at least the secondary grades.

70, 70a, 76, 76a, 76b, 76b', 77, 77a, 77b, 78, 78a, 78b, 79, 79a, 79b, 80, 80a, 81, 81a, 82, 82a, 82b, 83, 83a, 83b, 83b', 84, 84a, 84a, 84b

Z. A modern strand of functions and graphs that will progress through all grade levels is needed.

71, 71a, 71b, 72, 72a, 73, 73a, 73b, 74, 74a, 74a', 74b, 74b', 75, 75a

AA. There is the need to develop a modern strand of problem solving that will progress through all grade levels.

85, 85a, 85b, 86, 86a, 87, 87a, 87a', 88, 89, 89a, 89b, 89c, 90, 90a, 91, 91a, 92, 92a, 93, 93a, 93b, 94, 95, 95a, 96, 96a, 96b, 96c, 100, 100a, 100b

BB. The courses of algebra taught in the district need to be up to the level of standard modern tests in the subject.

97, 97a, 98, 98a, 98b, 99, 99a, 100, 100a, 100b, 101, 101a

CC. The mathematics beyond second year algebra needs to be evaluated very carefully in terms of its purposes as related to college entrance.

102, 102a, 103, 103a, 104, 104a, 105, 105a

CLASSIFICATION MATRIX OF NEEDS

A complete scope and sequence chart, such as those readily available from almost any textbook publisher, is not included in this report. It would be impossible to assess every item adequately in a limited number of days. The basis for the modified scope and sequence chart for the first eight grades actually used in this report is the Revised Strands Report of the California Statewide Mathematics Advisory Committee, especially Part I as reprinted in the October, 1967, issue of the Bulletin of the California Mathematics Council. This strands report is the most authoritative information available on what the state-supported curriculum in mathematics will be during the next five to ten years. It also provides the criteria to be used in selecting the new mathematics textbooks to be used in 1970, which makes it even more significant. Present practices are not as easy to evaluate using this set of criteria as are future trends, because some of the mathematics topics listed are not yet in present elementary texts.

Beyond grade eight, the basis for the scope and sequence chart used is as follows:

A. The assumption is made that the nine strands of the Strands Report should also be extended into the mathematics program of the high school years, especially for the terminal student.

B. New strands for the high school years are the standard courses of study labeled as first-year algebra (including introduction to algebra), second year algebra, trigonometry, and advanced mathematics beyond trigonometry. The geometry of the high school is considered a part of the geometry strand from the elementary grades. The course offerings in the traditional high school subjects are largely standardized

in existing textbooks, but trends in new high school books now being written are also considered.

The numbers in the section on major conclusions are keyed to the student needs and other columns of needs, rather than to the mathematical concepts of the matrix. The classification matrix pages are numbered so that a topic from the scope and sequence chart on page 1, for example, can be traced to the needs on the same horizontal position on various columns of pages 1a, 1b, and so on. This arrangement is necessary since all the columns connected with a concept cannot be put on a single sheet of paper.

The column reporting the various observations lists the grade level and a very concise statement of events for each separate classroom.

CLASSIFICATION MATRIX OF NEEDS

Number and Operations Strand

Societal Standards	Assessment Data
I. Whole numbers	
A. Understands concept of number and place value	Pre 1st--new child did not have concept of 2 or 3 1st-bundles of 10 and counting men 2nd-place value board 2nd-another name for a number 2nd-expanded notation, counting men and pocket chart 2nd--1-100 paper 2nd-expanded notation 2nd-practiced place value on page number 3rd-reviewed writing numerals up to 80,000 3rd-had chart for Roman numerals 4th-called zero a placeholder
B. Understands order relation on number line	Almost every elementary class had a number line 1st-mentioned number line, but did not use it
C. Be able to perform four fundamental operations 1. Possess skills	Pre 1st-used bead abacus for simple addition 1st-daily drill on fundamentals 1st- $\square + 8 = 12$ 2nd-16 - 9 = 16-6-3 =16-(6-3) Made error here 2nd-did paper on column addition 2nd-borrowing and carrying of 3 place numbers, with crutches 2nd-would not go into multiplication this year, but would drill more 2nd-column addition with carrying 2nd- addition and subtraction facts in the form of placeholder equations 2nd-subtraction of 3 place numbers with borrowing 3rd-relearning multiplication facts through use of distributive property

Strengths and Weaknesses	Learner Needs
Teaching the concept of whole numbers and place value occupies much of the time of the primary grades. Visual aids are often used to show grouping. Expanded notation is hard for many pupils to understand. One class of Negro pupils were already over a year behind in 2nd grade on number concepts. The role of zero is not always understood.	1. All pupils need to master 1-100 papers in the first grade. 2. All pupils need to understand that zero is a number.
B. All elementary classes have number lines available, but they do not seem to be used very often.	3. Pupils need to understand that the number line can continue to be used throughout mathematics to help develop number concepts.
C.1. Much of the time in arithmetic classes in elementary schools is spent in teaching and reviewing operations on whole numbers. Teachers prepare extra drill materials. Some feel guilty because they think they have been told not to drill in modern mathematics. The horizontal form is used, but the vertical form is more common. There is danger of elementary teachers making errors when using parentheses. Some second grade teachers did not introduce multiplication and division, even for superior students. In general, primary state texts are followed closely, with more emphasis on skill pages than developmental pages. Some rapid oral drill was observed. Review of fundamentals extends through	4. Pupils need to understand that drill is also a part of modern mathematics. 5. Pupils need to maintain the schedule of skill development suggested in state texts.

Instructional Needs	Administrative and District Needs
1a. Teachers need to give practice for mastery of 1-100 papers in first grade.	1b. District needs to decide on minimum program for every student to master in first grade.
2a. Teachers need to avoid calling zero a placeholder.	2b. District needs to be sure teachers understand zero as a number.
3a. Teachers need, without taking time from other areas, to refer to number lines more often to help develop concepts, rather than skills.	
4a. Teachers need to understand that modern mathematics also includes sufficient drill for mastery of skills.	4b. Need to publish official district position on modern mathematics and its relation to development of skills.
5a. Teachers need to plan to cover essential skills in text during year if at all possible.	5b. District needs to formulate a minimum program in mathematics for each grade level.
5a'. Teachers need to give diagnostic tests in skills and work on specific weaknesses.	5b'. Need to consider additional summer experiences for all pupils behind grade level in skills.
5a''. Teachers need to find out exactly how much progress children have made on skills during the year in their room.	5b''. Need to provide diagnostic tests as required, for individual use by teachers.
5a'''. Teachers need to be convinced that every child can master the fundamental skills of arithmetic.	5b'''. Need to encourage teachers to develop or use tests to be sure how much progress students have made during the year.
5a''''. Teachers need to explore ways of involving the home in efforts to bring up skill levels.	5b''''. Need to demonstrate that minority children can be successful in learning skills, over a long period of time.

Other Needs

1c. Every minority parent needs to be able to give concept of number to child prior to kindergarten.
1c'. Minority parents need to help with 1-100 papers at home.

4c. Parents may need to provide practice during the summer.

	3rd-rapid oral drill on facts 3rd-scaffold division 3rd-division facts in form of placeholder equations 3rd-subtraction of 3 place numbers, with borrowing 4th-2 place multiplication 4th-addition trail for practice 4th-add or multiply to get larger answer 4th-flash cards for review of multiplication facts 5th-daily drill on computation 5th-timed drill on multiplication facts 5th-pupils knew two ways to divide 5th-timed ditto on multiplication facts 5th-multiplication of 5 place number by 2 place number 6th-division of 7 place number by 3 place number 6th-rounded in division to estimate quotient 9th-review included in arithmetic tests
2. Understand relationships among different operations	3rd-scaffold division related to subtraction
3. Understand number properties	3rd-used distributive property in multiplication, but did not name it.
4. Understand identity and inverse elements	5th-worksheet using identity and inverse elements Alg-one as identity for multiplication
II. Rational Numbers A. Understand how they are related to integers	1st-concept of 1/2 and 1/2 of a set 3rd-concept of fraction

Strengths and Weaknesses	Learner Needs
elementary years, and takes a major part of the time in grades 4-6. There is little emphasis on quick estimates, but some timed tests on skills. Teachers have little information on the actual progress of students during the year, in terms of standardized information. It seems that minority children are often years behind in development of skills, though the problem is not confined to minority pupils.	6. Pupils need to understand the purpose of a developmental page. 7. Pupils need to memorize all facts for rapid recall. 8. Pupils need to be able to estimate answers very quickly. 9. Pupils need to understand what they are doing, as much as their ability and maturity level will permit.
2. Assessment was inadequate, but it seems that this idea from modern mathematics may not be adequately emphasized. 3. There was almost no use of technical vocabulary of properties at the elementary level. Properties are sometimes used without being named. 4. Prior to algebra, it seems rare to use the vocabulary of identity and inverse elements. The ideas are probably used frequently without being taught explicitly. A. Only in algebra was the definition of a rational number given. Various forms for rational numbers were not closely related to the set of integers. The introduction to fractions could have used more	10. Pupils need to understand the relationships among the four basic operations. 11. It is possible that pupils prior to 7th grade will need to know the names of number properties so they can do well on future standardized tests. 12. Pupils need to be able to use identity and inverse elements when necessary. 13. Junior high school students need to understand the concept and definition of a rational number prior to algebra.

Instructional Needs	Administrative and District Needs
5a'''''. Teachers need to create ways of teaching skills in as little time as possible, so that other mathematics will not be ignored.	5b'''''. The district should consider what minimum skills are essential before a student should be allowed out of the elementary school.
6a. Teachers need to understand that pupils should not practice developmental pages. They are used to help with understanding and concepts, and may often be used orally.	6b. Need to be sure teachers understand the purpose of developmental pages.
7a. Teachers need to be sure all pupils master appropriate facts for immediate recall.	
8a. Teachers need to encourage rapid estimating of answers.	
9a. Teachers need to teach for meaning as much as possible. They need to explain the why along with the how.	9b. Need to be sure all teachers understand the idea of teaching for meaning, and that it does not take the place of skills.
9a'. Teachers need to teach the scaffold division, at least as an explanation, but not necessarily as a skill.	9b'. The district needs to check the attitudes of new teachers about teaching for meaning.
9a''. Teachers at one grade level need to avoid making statements that will not be true at the next level, such as add or multiply to get larger answers.	
10a. Teachers need to be sure pupils understand how all four operations are related.	
11a. Teachers need to use technical vocabulary that will be needed on standardized tests.	11b. The district needs a policy for the grade level at which the names of various properties will be used.
12a. Teachers need to show pupils how identity and inverse elements are used to perform operations.	
13a. Junior high teachers need to teach the concept and definition of a rational number prior to algebra.	

Societal Standards	Assessment Data
	5th-introduction to fractions (just on page 99 of text) 6th-reading assignment on per cent Alg.- definition of rational number
B. Be able to use various names for the same rational number	3rd-using decimal point 5th-will omit ratios this year 5th-one group to begin decimals 5th-changing common fractions to decimal fractions 5th-relative size of 3 fractions 5th-drill on relative size of fractions 6th-changing from per cent to decimals and fractions in traditional way 7th-decimal expansion 7th-ratio and proportion with n 7th-pattern of moving decimal point when changing from decimal to per cent 7th-ratio and proportion with n 7th-trouble with concept of 3/4% 8th-knew about scientific notation 8th-ratios and proportion with x
C. Perform operations with rational numbers	5th-daily drill on computation 6th-addition of mixed numbers 6th-per cent and per cent graphs 6th-division of decimals as placeholder equations 6th-beginning per cent 6th-mechanical rule for placing decimal point in multiplication of decimals 6th-reviewed multiplication of decimals 7th-multiplication and division of mixed numbers 7th-division of fractions and mixed numbers 7th-multiplication with decimals 7th-could already do multiplication of mixed numbers 7th-practice on dividing decimals by inverting and multiplying 7th-compound interest problems Gen. math. Math Bingo each Friday Sen. math-formula for per cent

Strengths and Weaknesses

visual aids.

B. This concept is very widely taught, but more as an operation or a skill, rather than as a unifying concept. Some classes plan to skip ratios, and there should have been more applied work with them.

In general, when explanations were given, they were in traditional language only.

No visual aids were used for this work.

C. As was the case for whole numbers, operations with rational numbers are emphasized much more than the concept.

Though there are some exceptions, operations are in general taught in a traditional way, though there is somewhat more use of the horizontal form.

Many students in general mathematics and senior mathematics seemed to have much less skill in computation than many of the 6th and 7th graders.

Learner Needs

14. Pupils need to understand that rational numbers are an extension of the set of integers.

15. Students need to be able to change among various forms of names for the same rational number.
16. Students need to be able to use ratios in practical problems.
17. Students need exposure to modern explanations for the whys of changing forms with rational numbers.
18. Slower students need visual aids to help them understand the work with fractions.
19. Students need to understand the idea that a rational number has many names.

20. Students need to perform at least at grade level on fundamental operations with rational numbers named as fractions, decimals and per cents.
21. Pupils need to be exposed to modern explanations for the whys of the operations with rational numbers.
22. All pupils need a minimum competency in working with rational numbers prior to high school.
23. General mathematics and senior mathematics students need to know how much progress they are making in catching up in skills with rational numbers.

Instructional Needs	Administrative and District Needs
14a. Teachers need to show the rational numbers as an extension of the integers.	
16a. Teachers need to include more practical applications of ratios.	
17a. Teachers need to use modern language to explain the whys of changing forms of rational numbers.	17b. Need to be sure teachers have access to books using modern language for changing forms of rational numbers.
18a. Teachers need to use visual aids to help slower students understand rational numbers.	18b. May need to help some teachers prepare visual aids for teaching about fractions.
19a. Teachers need to unify the teaching of rational numbers by emphasizing that each rational number has many names.	
20a. Teachers need to find out at what grade level each student is performing on fundamental operations with rational numbers.	20b. Need to provide standardized tests as necessary to measure individual achievement.
21a. Teachers need to use modern language to explain the whys of operations with rational numbers.	21b. Need to be sure teachers have access to books using modern language to explain operations with rational numbers.
22a. Teachers need to assure minimum competence with rational numbers for all students entering high school.	22b. Need to establish a level of minimum competence in operations with rational numbers for all students.
23a. Teachers need to carefully measure progress of gen. math. and sen. math. students, and to make results available to students.	23b. Need to help teachers measure progress of students in general mathematics and senior mathematics.

Societal Standards	Assessment Data
D. Know properties of rational numbers	none
E. Be able to use number line with rational numbers	none
III. Understand negative integers	none
IV. Understand real numbers	5th-had introduced traditional method of finding square root 7th-knew about repeating decimals Pre. Alg.-2 methods of approximating square root
V. Understand complex numbers	none
VI. A brief treatment of bases other than ten.	7th-reviewed changing number from base 5 to base 10

Strengths and Weaknesses	Learner Needs
D. It is probable that very little emphasis is given to properties of rational numbers below grade 7. Quite a bit of material on properties appears in junior high texts, but it is likely that little of this is used with poorer students.	24. All junior high students need to be exposed to the properties of rational numbers.
E. It is probable that very little is done with this idea, though it is rather widespread in texts for grades 4-8.	25. Some students may need to use the number line to help understand the concept of rational numbers.
III. Negative numbers appear in texts for grade 6 and above. The assessment was inadequate. A guess is that slower students do not meet negative numbers until grade 7 or even later.	26. All students need intuitive work with negative numbers prior to a formal course in algebra. 27. Elementary students need to realize that numbers exist to the left of zero on the number line.
IV. The concept of a real number seems to be avoided until algebra. Methods of teaching square root differ widely. .	28. Junior high students need to understand the concept of a real number. 29. Junior high students need to understand a real number as a non-repeating decimal and as related to a point on the number line.
V. This appears in 2nd year algebra books now. It is probable that the concept will gradually come into the junior high school curriculum.	30. In the future, it is probable that students will need the concept of complex number prior to the 11th grade.
VI. After a few years of over-exposure as a typical topic in modern mathematics, this topic is declining. It seems to receive brief treatment when introduced. Its major value should be in helping to explain more about base 10.	31. Every pupil needs a brief introduction to number bases.

Instructional Needs	Administrative and District Needs
24a. Teachers need to expose all junior high students to properties of rational numbers.	
25a. Teachers need to use the number line when useful to help explain rational numbers. 26a. Teachers need to expose all students to work with negative integers prior to a course in algebra. 27a. Teachers need to make elementary pupils aware of the existence of negative numbers.	
28a. Junior high teachers need to present the concept of a real number.	
31a. Junior high teachers need to be sure each student has studied number bases briefly.	

Geometry Strand

Societal Standards	Assessment Data
A. Intuitive grasp of basic concepts of informal geometry	5th-class will study geometry last this year 5th-class had enjoyed geometry this year 6th-class will study geometry last this year
B. Wide experiences with informal geometry	same 3 above, also 5th-class had put geometric designs on board 6th-area of rectangle and surface area of cube 7th-area of rectangle and composite figures 7th-teacher put area drawings on board Appl. math.-using compass for basic constructions 10th-area and perimeter of rectangle and rectangular region
C. Understand concepts of three-dimensional space	6th-will study this at end of year 6th-surface area of cube
D. Understand concepts of congruence and similarity	10th-teacher discussed plans for test including congruence
E. Complete a course in coordinate geometry.	10th-equation of line through midpoint of two sides of triangle 10th-lecture on slope of line
F. Be able to use short chains of deductive reasoning	none
G. Complete a formal course in Euclidean geometry	4 observations from 10th grade listed above
H. Be introduced to the elements of modern geometry	none

Strengths and Weaknesses

A. These ideas occur in the state texts in grades 4-8, and most of the material seems to be covered with average classes at least.

B. The use of geometry in art must be inserted by strong teachers, since it does not appear very much yet in state texts.

Formulas for area seem to be covered by average students.

Applied mathematics courses seem to contain a strange mixture of topics. The topic of constructions does not seem like an applied topic.

Very little use of precise terminology was apparent in the geometry lessons.

C. Only a small amount of three dimensional geometry present in texts seems to be taught, probably in a rather formal way.

D. In general, these topics would be thoroughly studied in 10th grade geometry, using a postulational approach.

E. The equivalent of a course in analytic geometry would be covered by a student finishing the entire high school mathematics program.

F. Probably this does not appear prior to grade 10, but constitutes a major part of the ordinary geometry course.

G. The assessment was meager. From the text used, it seems that a standard course is presented. Other information came from talking to geometry teachers.

H. Very likely a student would scarcely encounter any geometry other than Euclidean.

Learner Needs

32. Students of lower ability also need an introduction to informal geometry.

33. Students need to appreciate applications of geometry in art and design.

34. Every student needs to master area formulas as a part of the minimum program.

35. Every student needs an introduction to construction as a part of the minimum program.

36. Students need to be familiar with the correct terminology of informal geometry.

37. Students need to use three dimensional models when necessary.

38. In the future, students need an intuitive introduction to congruence and similarity prior to the 10th grade.

39. Students who will take calculus need the equivalent of a complete course in analytic geometry as a part of their high school mathematics.

40. In the future, junior high students will need to meet short chains of deductive reasoning.

41. Students need a high school geometry course taught up to the level of existing modern textbooks.

42. Geometry students will need a brief introduction to finite, projective, and non-Euclidean geometries as part of their regular program.

Instructional Needs	Administrative and District Needs
32a. Teachers need to give all children an introduction to informal geometry.	32b. A minimum program for all students in geometry needs to be set up to be supplemented for those taking high school geometry.
33a. Teachers need to provide experiences with developing geometric designs or patterns.	33b. Teachers need to be encouraged to use existing transparencies to stimulate student creativity in applications of geometry.
34a. Teachers need to be sure every student masters standard area formulas.	
35a. Teachers need to include a brief introduction to constructions in the minimum program for all students.	35b. Demonstration equipment for constructions needs to be available for teachers as required.
36a. Teachers need to use correct terminology in geometry. They need to distinguish between sets of points and their interiors.	36b. Need to be sure teachers are confident of terms in geometry. 36b'. Need to be sure teachers understand the aims of teaching geometry at each level.
37a. Teachers need to use three dimensional models when helpful.	37b. Need to encourage teachers to prepare three dimensional models. May need to provide some from the district.
38a. Junior high teachers will need to present an intuitive introduction to similarity and congruence.	
39a. Secondary teachers will need to make sure a complete course in analytic geometry is covered by students taking calculus.	39b. Need to establish a strand of analytic geometry throughout secondary mathematics.
40a. Junior high teachers will need to present brief chains of deductive reasoning.	
41a. Teachers of high school geometry need to be sure they are teaching a standard course acceptable as college preparation.	41b. Need to continue to check the level of the high school geometry course to insure that quality is maintained.
42a. Teachers need to provide students a glimpse of finite, projective, and non-Euclidean geometries.	42b. Need to be sure training of geometry teachers includes some knowledge of modern geometries.

Societal Standards	Assessment Data
A. Measurement is a doing process	1st-introduction to clock 1st-telling time 2nd-minority students just learning to tell time 2nd-making change 5th-minority students reviewed telling time 6th-area of rectangle
B. Measurement is an application of arithmetic skills	6th-area of rectangle 7th-area of composite figures using mixed numbers 7th-area of composite figures 8th-solving money problems
C. Understand concept of what a measurement is	none
D. Be able to use standard units	3rd-had linear measurement chart on wall 5th-changing 2 ft. 4 in. to inches 5th-time zones, leap year, weeks in a year 6th-reviewing linear measures 8th-linear metric measure 8th-had worked on metric system
E. Development of standard mensuration formulas	6th-area of rectangle and surface area of cube 7th-area of rectangle and composite figures 10th-area and perimeter of rectangle
F. Become bilingual in the English and metric systems	8th-linear metric measure and approximate conversion to English units 8th-had worked on metric units
G. Understand measurement as a function	none

Strengths and Weaknesses	Learner Needs
A. Primary teachers emphasize activity in measurement. Probably it is not emphasized in upper grades as much. Some minority children were far behind in development of measurement skills.	43. Students beyond primary grades need experience with an activity approach to measurement. 44. Some slow learners need to catch up to grade level on measurement skills.
B. This was not observed below grade 6, but probably is common, since this is the traditional way of presenting measurement.	45. Students need to apply work with each new set of numbers studied to geometry formulas.
C. The concept of measurement does not seem to be presented from a mathematical point of view. No use of non-standardized units was observed.	46. Students need to understand the mathematics of what a measurement really is. 47. Students need experiences with non-standardized measurements.
D. This traditional material is widespread, but many slow students are years behind in skill development. The only metric units noticed were linear.	48. Students need to be exposed to all common standard measuring units, and to be able to convert from one to another.
E. Most of this work seems to be in junior high years. Nothing more complex than rectangle was observed below that level.	49. Students need to master all the common mensuration formulas prior to 9th grade.
F. Minimum courses on the metric system are taught in the 8th grade. No attempt is yet made to have students become bilingual. The metric system is not yet in elementary texts.	50. In the future, students will need to be bilingual in the English and the metric systems. Now, they need to be able to use the metric system in applications.
G. This topic is not yet in any texts, and may not appear even in the new adoptions.	51. In the future, students may possibly need to think of measurement as a function.

Instructional Needs	Administrative and District Needs
43a. Teachers beyond primary grades need to include experiences in an activity approach to measurement.	43b. Need to provide teachers with suggested activities involving measurement.
44a. Teachers need to help slower students make progress in catching up to grade level in measurement skills.	
45a. Teachers need to relate each new set of numbers studied to geometric applications involving measurement.	
46a. Teachers need to explain the concept of what a measurement is.	46b. Need to be sure teachers thoroughly understand the concept of a measurement.
47a. Teachers in elementary grades need to provide many experiences with nonstandardized units.	
48a. Teachers need to expose all students to common measuring units.	
49a. Teachers need to be sure every student masters the standard mensuration formulas prior to the 9th grade.	49b. Need to develop a minimum program of measurement formulas for each year for all pupils.
50a. Teachers need to prepare to teach future students to be bilingual in the metric system.	50b. Need to be sure elementary teachers are sufficiently prepared to teach the metric system thoroughly.
51a. Teachers need to study the possibility of teaching measurement as a function.	

Applications of Mathematics Strand

Societal Standards	Assessment Data
A. Understand construction of a mathematical model	none
B. Ability to solve a wide variety of concrete problems.	5th-writing checks and paying bills 6th-played investing in stock market 8th-discussed application of metric system 8th-learning to use slide rule 8th-learning to use slide rule Gen. math.-making up questionnaire as application of statistics Sr. math.-cost of owning duplex Sr. math.-began idea of checking account
C. Students should propose areas of investigation of interest to them.	Gen. math.-students deciding on topic for questionnaire in statistical application Simple problems proposed by various students for solution with computer

Strengths and Weaknesses	Learner Needs
A. It is doubtful that many students meet this idea prior to college, except when they use mathematical sentences to solve written problems.	52. Students need to understand concept of an abstract mathematical model for a concrete applied problem. 53. Students need practice in actually setting up a mathematical model.
B. In most cases, the best applications were those that resourceful teachers had inserted on their own for enrichment. In general, few applications were encountered. In senior math., the applications do not always seem really practical to the students.	54. Less able children need business applications such as checks and possibly the stock market. 55. Students will need to become bilingual in the use of the metric system. 56. Students need to relate their experiences with the metric system to work in the arithmetic texts. 57. Every student needs to be familiar with the slide rule, and to be able to use it for simple work.
C. Few opportunities are provided for students to use their initiative in suggesting areas of application.	58. Students need to propose areas of investigation of applications of interest to them. 59. Less able students need an acquaintance with calculators and with trying to set up their own problems for them.

Instructional Needs	Administrative and District Needs
52a. Teachers need to introduce the concept of a mathematical model, and give practice in setting up such a model.	52b. Need to make sure teachers understand the idea of a mathematical model in the abstract sense.
54a. Teachers need to expose all children to check writing and other business applications.	
55a. Teachers need to teach the metric system so that students are familiar enough with it to work without converting to the English system.	55b. Need to provide teachers enough information about the metric system so they are confident.
57a. Teachers need to introduce the slide rule to all students.	57b. Need to be sure all secondary teachers can use a slide rule for simple work. 57b'. Need to have inexpensive slide rules available for teaching purposes.
58a. Teachers need to provide opportunities for students to suggest applications.	58b. Need to collect good applications from teachers for distribution for others to try.
59a. More calculators are needed in various classrooms.	59b. Need to provide help for teachers to become familiar with uses of simple calculator--computers.
59a'. Teachers in all schools at secondary level need to arrange a time when students can use a calculator.	59b'. Need to provide, as soon as financially practical, more simple calculators for classroom use. 59b''. Counselors need information on current job opportunities connected with computers.

Other Needs

54c. Businesses and banks need to furnish free business forms such as checks for use in classrooms.

Statistics and Probability Strand

Societal Standards	Assessment Data
A. Understand rudiments of organization of data into standard graphs and charts	See strand on functions and graphs.
B. Understand meaning of various averages	none
C. Aware of meaning of variance and standard deviation	none
D. Familiar with elementary notions of probability	none
E. Familiar with elementary notions of statistical inference	Gen. math.-questionnaire to be made and analyzed by students

Strengths and Weaknesses

A. See strand on functions and graphs.

B. Probably this is taught as it appears in the regular texts.

C. Probably this is not introduced, since it does not now appear in elementary or secondary texts. In the future, these will become required topics, probably in grade 11 or 12.

D. Two years ago, 26 classes in Fresno took part in an experiment using SMSG probability units.

E. This idea is likely to be met only in junior high school or in classes for terminal students.

Learner Needs

See strand on functions and graphs.

60. Every student needs to be able to find the mean, median and mode prior to high school graduation.

61. Within about 5 years, students who will go on in mathematics will need to know how to find the variance and the standard deviation.

62. All students need to meet fundamental ideas of probability before graduation from high school.

63. Students need an experimental approach using concrete materials.

64. All students need to understand elementary notions of statistical inference prior to graduation from high school.

Instructional Needs	Administrative and District Needs
See strand on functions and graphs.	See strand on functions and graphs.
60a. Teachers need to make sure all students are exposed to all 3 averages.	
61a. Teachers of grades 11-12 need to plan to include variance and standard deviation during the next five years.	
62a. Teachers need to make sure all students are exposed to basic ideas of probability before high school graduation.	62b. The district needs to devise a sequence of essential topics in probability and statistics extending from about grade 6 upward.
62a'. A reasonable strand of probability and statistics needs to be developed that will extend through the years of secondary school.	62b'. Need to be sure secondary teachers are provided with resource materials necessary to teach probability and statistics.
	62b''. Need to be sure secondary teachers have mastered essential content in probability and statistics.
63a. Teachers need to provide an experimental approach to probability using concrete materials.	
64a. Teachers need to make sure all students are exposed to basic ideas of statistical inference before high school graduation.	

63c. Businesses using probability and statistics need to provide teaching materials showing practical applications.

Sets Strand

Societal Standards	Assessment Data
A. Use sets to explain number concepts.	1st-used term half of a set
B. Use sets to explain meaning of operations	3rd-sets of books used to develop concept of division
C. Use of set language when convenient	Only the other entries in this same column
D. Understand set operations and properties	Alg.-mentioned union of two sets
E. Apply sets in logic	None

Strengths and Weaknesses	Learner Needs
A. Ideas from sets appear in primary books but not grades 4-6. It is doubtful that teachers use set concepts to explain numbers if the text does not.	65. Students need to be able to use set language to describe collections of numbers. 66. Students need to think of extensions of number systems as related to sets.
B. It is probable that primary teachers do more of this than teachers in grades 4-6, because of the texts.	67. Students need to relate operations with numbers to the language of sets.
C. Very little use of set language seems apparent. Teachers miss many opportunities to use the ideas with no extra time involved. Major ideas such as the fact that set language permeates mathematics seem to be missed at all levels by most teachers.	68. Students need to be used to hearing set language throughout mathematics.
D. Some students get these ideas in junior high school. All students need to meet them, including the concept of Cartesian product.	69. Students going on in mathematics need to be familiar with set operations and properties so they can be used in abstract mathematics.
E. Present texts do not have logic. It is possible that some students have been introduced to the connections between Venn diagrams and truth tables.	70. Students going on to college mathematics need to understand the applications of mathematics in logic.

Instructional Needs	Administrative and District Needs
65a. Teachers need to use set language as convenient to explain concepts of numbers.	65b. There is a need to convince teachers that set language can be used often without taking time from other topics.
66a. Teachers need to explain extensions of number systems using set language.	
67a. Teachers need to explain operations with numbers using set language when convenient.	67b. Probably many teachers still need more confidence in explaining arithmetic using sets.
68a. Teachers need to use set language throughout the year to keep students familiar with the words, when they can be used naturally.	
69a. Teachers need to decide which students will need information about set operations because of their future work in mathematics.	69b. The minimum essentials in set language and operations for all students continuing with college mathematics need to be determined.
70a. Teachers need to prepare many students to apply set operations in logic.	

Other Needs

67c. Parents need to understand that set language is normally not used for its own sake alone, but to help students understand the topic being studied.

Functions and Graphs Strand

Societal Standards	Assessment Data
A. Introduce relation and function concept through ordered pairs in elementary school	none
B. Understand simple statistical graphs	5th-class had already finished graphs 6th-were doing per cent graphs 7th-had made bar graphs, and understood there was more than one correct way to make them
C. Standard function notation employed in junior high school	none
D. Ability to graph relations and functions in 1 and 2 dimensions	none
E. Understand special types of functions and operations with functions	none

Strengths and Weaknesses	Learner Needs
A. This topic does not appear in present state texts, but is very likely to be in new ones.	71. When new texts are adopted, elementary children will need to be introduced to the concepts of functions and relations.
B. The minimum of work appearing in texts seems to be covered, at least with average and above average students.	72. Terminal students need to be able to interpret statistical graphs.
C. This topic does not appear in present state texts, but is very likely to be in new ones.	73. When new texts are adopted, 7th and 8th grade students will need to be able to use the function notation.
D. These topics are covered in grades 7-10, mainly in algebra and geometry courses, but without use of function terminology. The committee for 9th grade algebra has excluded the function chapter from the required course.	74. Students need to meet the function concept in grade 9, and to hear the language used widely in traditional courses.
E. The traditional course includes trigonometric and exponential functions. The concept is used in advanced placement courses.	75. Students continuing with calculus need to understand the function concept thoroughly before beginning calculus.

Instructional Needs	Administrative and District Needs
71a. When new texts are adopted, teachers need to include all available material on functions in the course of study.	71b. Elementary teachers need to understand the concept of function and relation so they can teach it in the new texts.
72a. A minimum program for all students needs to be established to include statistical graphs.	
73a. Teachers in grades 7 and 8 will need to teach the function notation in new texts.	73b. Junior high teachers need to be prepared to use correct language and notation when teaching the function concept.
74a. Grade nine teachers need to reconsider the course of study to include function when it is introduced in earlier grades.	74b. Within a few years, the district will need to develop a strand for teaching the function concept from about grade four.
74a'. Teachers in present traditional courses need to continue to use the correct technical language of relation and function after it has been introduced.	74b'. High school teachers need to be encouraged to use the correct technical vocabulary for function when convenient.
75a. Teachers need to prepare calculus students by introducing the function concept before calculus.	

Logical Thinking Strand

Societal Standards	Assessment Data
A. Understand that equality means two different names for the same thing	2nd-another name for number
B. Understand inductive side of mathematics	none
C. Understand if-then reasoning and the rules of inference	none
D. Be able to use logical connectives such as and and or	Alg.-related connective or to union of sets.
E. Understand role of negation	none
F. Use of some qualtifiers	none
G. Understand notion of proof	In geometry classes only
H. Formal chapter on logic in high school (including introduction to truth tables)	none
I. Terminal students introduced to logic	none

Strengths and Weaknesses	Learner Needs
A. Teachers missed at least ten good opportunities to talk about names for a number and the significance of the equals.	76. Students need to hear the correct vocabulary used to explain equals as two names for the same thing.
B. It is doubtful that this concept appears very often in Fresno classrooms at any level.	77. Students need to appreciate the inductive approach to mathematics, using intuition.
C. The use of if-then statements is probably confined to high school proofs in algebra and geometry.	78. Students need to see if-then statements and to make them prior to the ninth grade.
D. Probably this does not appear in classrooms prior to algebra now.	79. Junior high students need to match set language and logical connectives.
E. This probably is not taught in grades 1-8.	80. Junior high students need to be able to write the negation of a statement.
F. The topic probably is not taught in grades 1-8.	81. Junior high students need to be exposed to the use of some and all as quantifiers.
G. It is doubtful that formal proofs appear very often below grade nine. Proof in arithmetic is used to mean check the answers. Few formal proofs were observed in high school.	82. Students need to understand the difference between a proof and a check, and to begin to distinguish between informal proofs and formal deductive proofs prior to algebra. High school students need practice with formal proofs.
H. Geometry books now being written generally contain this. It is probably not taught now, except for small parts appearing in geometry texts.	83. Soon, all pupils going on in college mathematics will be expected to be familiar with this material, so it will need to be presented to them.
I. Students taking general mathematics seem to get no introduction to logical thinking.	84. Every high school graduate needs some introduction to logic.

Instructional Needs	Administrative and District Needs
76a. Teachers should look for opportunities to use the correct language to explain equals.	76b. Need to be sure elementary teachers understand the idea that a number has many names. 76b'. Need to keep reviewing this idea in high school.
77a. Teachers need to be able to encourage use of inductive arguments prior to generalizations.	77b. Need to be sure teachers have available examples of the use of induction in mathematics.
78a. Teachers need to put statements in if-then form more often.	78b. Need to be sure teachers understand the premise-conclusion form of if-then statements.
79a. Teachers need to relate the language of sets and logical connectives. 80a. Teachers need to explain how to form the negation of a statement. 81a. Teachers need to explain the meaning of all and some in precise logical usage.	79b. Need to encourage teachers to use set language and relate it to logical connectives.
82a. Teachers need to bring in more informal proofs earlier.	82b. Need to be sure that teachers use the word prove correctly in arithmetic.
83a. Teachers need to decide on the amount of logic and its placement in the high school sequence.	83b. Need to check to see if new teachers are being prepared to introduce logic. 83b'. Need to see that teachers have studied truth tables.
84a. Teachers need to experiment to see what logic can be taught to terminal students.	84b. Need to experiment to see if teaching some elements of logic to terminal students will help their scores on standardized tests.

Problem Solving Strand

Societal Standards	Assessment Data
A. Able to construct diagrams and use concrete materials to solve problems	none
B. Able to guess reasonable answers	none
C. Able to translate into mathematical sentences	Alg.-solved digit problems Alg.-word problems with 2 equations in two unknowns Inter. Math.-problem with growth of colony of bacteria
D. Performance of mathematical analysis and interpretation of answer	4th-verbal problem with addition or multiplication. Did problems orally together 7th-verbal interest problem 8th-solved money problems. Teacher read them and explained process
E. Pupils encouraged to use intuition and to discover various methods	none
F. Inclusion of enrichment and recreational problems	Intro. to alg.-enrichment problem concerning 5 and 3 gallon container
G. Formulation of practical problems by students	6th-problems connected with play investing in stocks Two schools visited allowed students to propose problems for solution with a small computer.

Strengths and Weaknesses	Learner Needs
A. This idea is probably not used as often as possible, especially beyond the primary level.	85. Slower students need to learn to use concrete materials when necessary. 86. All students need to learn to construct a diagram if helpful.
B. This idea of guessing is probably rarely used.	87. All students need to be able to quickly guess the answer to a problem before working it, and to observe if their final answer is reasonable.
C. Probably this technique is much more common at the secondary level than the elementary level. It has long been a part of traditional algebra.	88. Students below the level of algebra need to begin to translate problems into mathematical sentences when helpful.
D. Lack of reading skill is a great limitation in teaching problem solving. Much of problem solving is done orally together. The method of checking is not stressed.	89. Students need to be able to read well enough so it will not cause difficulty in teaching word problems. 90. Students need more practice in solving word problems independently. 91. Students need to check their work more often.
E. This is probably hard for teachers to accomplish, except for very bright children. Teachers manuals contain few good ideas to help in this.	92. Students need to be encouraged to discover more than one way to solve a problem.
F. Probably a limited amount of these problems are introduced, depending on the individual teacher. A junior high curriculum committee is making a collection of resource materials that should include this type of problem.	93. Students at all ability levels need some exposure to recreational problems. 94. Poor students need recreational problems closely related to skills they should learn.
G. Some individual teachers are able to stimulate activities, but textbooks do not help much. The computers are a valuable motivational device.	95. Students need to be encouraged to bring real problems to class. 96. Every student needs the experiences of formulating a simple problem to be solved on a computer.

Instructional Needs	Administrative and District Needs
85a. Teachers need to be sure a variety of concrete materials are available to use as necessary.	85b. There may be a need to supply some concrete materials if any elementary classrooms are without them.
86a. Teachers need to encourage students to make diagrams when they might be helpful. 87a. Teachers need to encourage estimating mentally before solving a problem. 87a'. Teachers often need to ask if an answer(especially a wrong one) is reasonable or not.	
89a. Teachers need to help students learn to read arithmetic problems for themselves.	89b. There is a need to fully explore the connection between low reading ability and solving problems in mathematics to see if children can be taught to read mathematics problems in mathematics classes or in reading classes.
90a. Teachers need to provide opportunities for students to solve problems independently. 91a. Teachers need to have students check their work more often. 92a. Teachers need to encourage children who discover another correct way to work a problem.	
93a. Teachers need to have a supply of recreational problems available to the class.	93b. There is a need to share good recreational problems among teachers.
95a. Teachers need to encourage students to bring real problems to class. 96a. Teachers need to provide opportunities for all students, if at all possible, to have some experience in preparing a problem for a computer to solve.	96b. There is the need to make available, as soon as financially possible, a small computer for use by any secondary teacher desiring to give his class some experience with it.

89c. Some parents, when able, need to help their children learn to read mathematics problems.

96c. Industries actually using computing equipment need to invite classes to see how it is used in practice.

First Year Algebra Strand

Societal Standards	Assessment Data
A. Possess basic algebraic skills	8th-multiplication of binomials Intro. to alg.-great trouble with subtraction of algebraic fractions Intro. (2)- solved set of 2 linear inequalities. Vocabulary and method were traditional Alg.-solving quadratic equations Alg.-used cancel in solving quadratic equations Alg.-simplification of radicals Alg.-working with radicals
B. Understand basic algebraic concepts	Intro.-concept of opposite Intro.-distributive property over subtraction Intro.-correct usage of number and numeral Alg.-introduction to polynomials Alg.-explained parameter District outline omits functions
C. Have experiences with applications and written problems	Intro.-digit verbal problems Alg.-word problems with 2 equations in 2 unknowns

Strengths and Weaknesses	Learner Needs
A. It seemed that most teachers were teaching a rather standard course, with emphasis on skills. There was little use of techniques other than the lecture method. What was expected of the students varied from one school to another, depending on the socio-economic level.	97. Students need to participate more in questions and discussion. 98. Students in schools in lower socio-economic areas, who take algebra, should complete all of a standard course.
B. Possibly the emphasis on concepts and understandings should have been somewhat heavier. They tended to be taught separately, and not in connection with skills.	99. Students need to have a proper balance of concepts and skills, taught together, in a modern program of algebra.
C. Only traditional-type problems were observed. There was no attempt to relate algebra to the world of the student.	100. Students need to be able to use the tools of algebra to solve practical problems as well as traditional types.

Instructional Needs	Administrative and District Needs
97a. Teachers need to experiment more with teaching techniques other than the straight lecture in algebra.	
98a. Teachers in low socio-economic schools need to be sure the algebra course their students take is equivalent to those in the other high schools.	98bThe district needs to guarantee some basic competencies in algebra for every student completing the course.
99a. Teachers need to think about how to achieve a balance between skills and concepts in algebra, and how to present both as a meaningful whole.	
100a. Teachers need to search for some real applications of elementary algebra to present.	100b. Need to distribute creative ideas of best teachers in algebra.

Second Year Algebra Strand

Societal Standards	Assessment Data
A. Further development of algebraic skills.	11th-gave test on skills 11th-solution of a second degree equation with two variables
B. Further development of concepts and understandings	11th--spelling test on vocabulary
C. Exposure to applications and verbal problems	11th-problem with growth of bacteria colony

Strengths and Weaknesses

A. The assessment was very incomplete, so that few conclusions are possible. Compared to other districts where larger numbers of students go to four year colleges, there are few classes of second year algebra in Fresno.

B. From the topics that were being taught, it seems the classes will not cover many topics in the last 1/3 of the text.

C. The usual problems from the text were taught.

Learner Needs

101. Second year algebra students going on in mathematics need to be exposed to almost every topic in the text, since few colleges offer college algebra.

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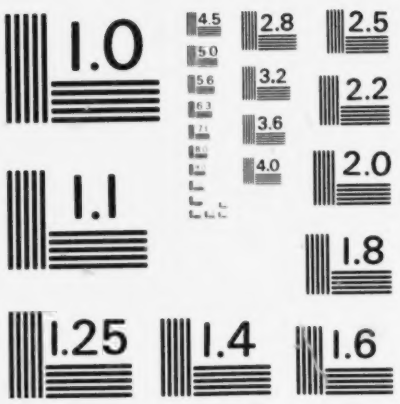

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

Instructional Needs

Administrative and District Needs

101a. Teachers need to attempt to save time on the review at the beginning of the year so that more time can be spent with new topics nearer the end of the text.

Mathematics Beyond Second Year Algebra

Societal Standards	Assessment Data
A. Complete the equivalent of a complete course in trigonometry	Trig.-class of only 4 students in minority school
B. If a calculus course is given, it should be the equivalent of the same type course at the college level.	Calc.-derivative of a logarithm Calc.-review of properties of logarithms and oral drill

Strengths and Weaknesses

A. The assessment was inadequate, partly because there are few classes in trigonometry meeting in the afternoons.

B. The assessment was inadequate. Seemingly, the advanced placement program is preparing students well. The number of students is small.

Learner Needs

102. Every student beginning calculus needs the equivalent of a college course in trigonometry.

103. Students need to be prepared to take an advanced course rather than the beginning course in college mathematics if they take calculus in high school.

104. Students need to be prepared to pass an Advanced Placement examination, but this should not be the main goal of the course.

105. Students need the equivalent of a complete course in analytic geometry by the time they finish the advanced placement program.

Instructional Needs

102a. Teachers should be sure the sequence of topics in trigonometry constitutes the equivalent of a complete course.

103a. Teachers need to prepare students for an advanced college course in mathematics.

104a. Teachers need to prepare students for the Advanced Placement test, without undue emphasis on it.

105a. Teachers need to be sure all topics in modern analytic geometry are covered by the time the advanced placement program is completed.

Administrative and District Needs

Climate in Classroom - Teaching Techniques

Societal Standards	Number of Observations
A. Adequate use of audio visual materials	23
B. Emphasis on more than one correct way to solve a problem	2
C. Provision of supplementary learning activities	7
D. Provision of individual help	4
E. Provision of an individual program for some students	2
F. Wise use of drill materials	10
G. Pupils sometimes work without using the text	3
H. Class reads aloud together	1
I. Pupils allowed to work at board	2
J. Use of rapid oral drill	5
K. Grouping within some classes	3
L. Teachers attempt to stimulate discovery	0

Strengths and Weaknesses	Learner Needs
A. Overhead projectors are plentiful in most schools. Teachers use a lot of audio visual materials, and many of them are homemade.	
B. This concept appears only in certain types of problems. It is likely many teachers do not consider this aspect of mathematics very often.	106. Pupils need exposure to the idea that there is often more than one way to solve a problem.
C. Many other teachers had used these materials previously. In general, such materials are used only with above average students.	107. Many pupils need to study new ideas in supplemental materials, as well as regular texts.
D. Many other teachers normally provide individual help as necessary during supervised study periods.	108. Pupils, especially slower pupils, sometimes need individual help.
E. Ordinarily, it is virtually impossible for a regular classroom teacher to provide individualized programs for every student.	109. A few students may need completely individualized programs in mathematics.
F. Probably most teachers used additional drill materials during the year. It was an almost universal complaint that state texts did not contain enough drill material.	110. Pupils sometimes need additional drill on important skills, besides that found in their texts.
G. This technique is fine part of the time. If carried to extremes, it may mean the pupil will not learn how to read the text, and will never see a complete development of a topic.	
H. This technique helps slower students with reading problems.	
I. Many classrooms have relatively little board space. The technique should probably be used more widely.	
J. This is a time-saving technique of great value. It should be used much more widely.	
K. Many students are in homogeneous groups. Grouping within a class permits pupils to progress more at their own pace, but means that the teacher can spend only part of her time with each group.	
L. This cornerstone of the method of modern mathematics is difficult to develop in a typical classroom. It is probable that some teachers in Fresno do attempt it.	111. Pupils need the experience of attempting to discover something in mathematics for themselves.

Instructional Needs	Administrative and District Needs
106a. Teachers need to emphasize there is often more than one correct way to work a problem.	
107a. Teachers need to provide supplementary materials when they would be helpful.	107b. The district needs to attempt to provide special supplemental materials when needed by a teacher.
108a. Teachers need to give as much individual help as possible to those students needing it.	108b. The district needs to relate the size of classes to the amount of individual help a teacher is able to give.
109a. Teachers need to provide a completely individualized program if that would be best for a particular pupil.	109b. Some teachers may need help in planning an individual program for some exceptional pupils.
110a. Teachers need to provide additional drill beyond that found in the text when they feel it is necessary.	110b. Some teachers may need help in choosing good additional drill, and in deciding how much of this material should be used.
111a. Teachers need to provide experiences through which pupils can make discoveries in mathematics.	

Other Needs

108c. Parents need to accept the responsibility of providing additional individual help at home when necessary.

Societal Standards	Number of Observations
M. Encourage spirit of open and free investigation	0

Strengths and Weaknesses

N. Textbooks rarely present mathematics as a subject for open and free examination. There was no evidence of a laboratory approach, except possibly as related to work on a computer.

Learner Needs

112. Pupils need exposure to the concept of a laboratory approach in mathematics, emphasizing a spirit of open and free investigation.

Instructional Needs	Administrative and District Needs
112a. Teachers need to provide some experiences in a laboratory setting, emphasizing a spirit of open and free investigation.	

HISTORICAL DETAIL

Experimental programs in modern mathematics at the secondary levels began in California about 1958-1959. Elementary experimental programs followed about 1960. It was several years after these dates that the programs became widespread in the secondary schools, and not until the present textbook adoption that they became widespread at the elementary levels. The Bay Area and the Los Angeles area naturally led in the experimentation, but Fresno had early contacts with the programs, especially SMSG, and leaders from Fresno gained prominence throughout the state. It is to be expected that teachers in Fresno would have fewer opportunities to study and to learn to appreciate modern mathematics than is true in some other parts of the state, in spite of an intensive in-service program. It is also accepted that the district seems somewhat more conservative than some of those in the two major population centers of the state.

The initial period of introduction of modern mathematics into the secondary schools of Fresno lies in the past. Second generation commercial texts with modern ideas are now being widely used. At the elementary level, the initial period will close in 1970 when the present texts are changed. There has been a natural concern when some evidence indicated that the introduction of modern mathematics resulted in a decrease in skill levels as revealed by standardized tests. Teachers have now attempted to compensate for this, but the proper balance in teaching both concepts and skills is still being sought.

The rest of this section includes some generalizations about various strands in the classification matrix of needs, so that the reader may more easily interpret the needs in the light of current trends.

The typical visitor to a Fresno mathematics classroom below grade nine is most likely to see students drilling on fundamentals of arithmetic. This is not necessarily meant as a criticism, but it is true that this one facet of the program dominates all others, hence there are many concepts that are in the other strands that are scarcely presented at all. As long as state tests do emphasize computation and a narrow assortment of rather traditional concepts, this approach is adequate, and so far has managed to keep the schools of Fresno near the average for the state. It is a natural outcome of the initial decline in computational skills in connection with the use of modern texts in the elementary grades. There is considerable frustration among teachers who feel that drilling is something they are not supposed to do in modern mathematics, and it was probably this same false notion that caused some of the decline in skills in the first place.

The real problem for the future is how to maintain at least the same skill level and yet find the time to introduce many new concepts included in the Strands Report that are beginning to appear

on standardized tests. At this very moment, state tests are being designed to test concepts in the Revised Strands Report. Unless many changes take place in Fresno schools, it seems inevitable that future tests really will test many items pupils have never encountered. Once again, it is important to emphasize that no decline in skills should be accepted. It will simply mean teaching more material in the same amount of time.

A large part of the time of instructors in grades 9-12 is also devoted to teaching these same fundamental skills of arithmetic to students who have not yet mastered them. At this level, the problems of motivation are more acute, and it is a rare teacher who is satisfied with the progress he sees students making. Some students, especially those in low socio-economic areas, are exposed to little beyond the fundamental operations. This seems to make sense when a teacher explains how weak they are on fundamentals. It does not seem reasonable that modern mathematics is appropriate for students who cannot add well, yet present experiments seem to indicate that most children can indeed learn abstract mathematics. The problem is how well can they learn it under the existing conditions in the Fresno classrooms.

In general, the geometry strand consists of the topics in the state texts. It seems to take little time, and often serves as an interesting topic to relieve the study of arithmetic operations. So far, it is not really a very significant strand in Fresno, before the formal course in high school geometry.

The entire approach to the teaching of measurement is changing, though this approach is not yet evident in Fresno. Measurement, it is advocated, should be taught as an activity, should begin to emphasize the metric system, and should be an extremely useful application of arithmetic. Instead, it is sometimes taught as an abstract topic in which the student simply fills in the blanks on the text page. The primary teachers seem to be nearer the spirit of teaching modern measurement than teachers at higher grade levels.

In Fresno, there is relatively little emphasis on the applications of mathematics, especially with college preparatory students, but there are signs that the widespread use of small computers may be helping the situation. Applications, somehow, must be made significant in the lives of the students.

The statistics and probability strand is one that will become more important during the next five to ten years, but now there is certainly no strand apparent throughout the grades. This strand is closely related to the one on applications.

The sets strand has faded somewhat from its former eminence at the beginning of modern mathematics, and this is good. The set language is important, because set concepts are not taught for their own sake at the elementary levels, but as a tool to help in the learning of arithmetic.

The function and graphs strand is one that will become much more important as the concept of function begins to appear in texts at lower grade levels. At the moment, in Fresno, there is inadequate understanding, even among secondary teachers, of the future significance of the function concept.

There is still considerable opposition to making logic an integral part of the mathematics curriculum. In spite of this, the trend throughout the nation is to teach more and more logic at an earlier and earlier level. Experiments have shown that some logic can be taught in elementary grades, and textbooks are beginning to reflect this trend. A formal chapter on logic is becoming an accepted part of the high school mathematics background for students going on with mathematics. There seems no indication that Fresno schools are teaching logic yet.

Problem solving appears in every mathematics course, yet it is not ordinarily thought of as a strand in its own right. One of the difficulties connected with problem solving is that it depends upon reading ability, as well as intelligence. This penalizes many children who may have more trouble reading than they have understanding arithmetic.

With the phasing out of introduction to algebra courses, Fresno is coming to accept the pattern of a single course in first year algebra that is appropriate for all students with sufficient background. In spite of the text, algebra courses in Fresno seem to be only slightly modern in spirit. There are some exceptions to this rule, but they depend on a few teachers with a stronger background.

Second year algebra is a more specialized course for a selected group of qualified students. The strength of the course depends on how far students get in the text, to some extent, because the last part contains many essential topics for the person going on in mathematics.

There is not as much standardization of courses beyond second year algebra as during the early years of high school. The advanced placement program has complicated the issue of how much separate trigonometry and analytic geometry should be taught, and when. A smaller proprotion of students take work beyond second year algebra in Fresno than in other districts where the per cent of students entering four year colleges is higher. Across the nation, the trend seems to be that more and more students are taking advanced mathematics to prepare them for college mathematics. There is also evidence that the per cent of students taking general mathematics is declining.

The Revised Strands Report, as compared to the original, makes a big issue of what is called "The Climate in the Classroom." It is not widely known among the lay public that the philosophy and method of teaching mathematics is possibly even more significant in modern

mathematics than is the introduction of new content. On the other hand, significant changes in the typical mathematics classroom have been disappointing. As a result, the ordinary teacher is teaching some modern mathematics, but in about the same way he taught before. Partly because of the fact that it was not involved in the initial experimentation, Fresno does not seem to have a large group of teachers deeply committed to a truly modern approach and eager to carry on experimentation. Its schools must satisfy fairly conservative parents, and there seems little indication that there will be any significant changes in any of the positions stated in this paragraph. For practical purposes, we must conclude that minority children, in particular, in Fresno are exposed to very little modern mathematics taught in a modern way. Whether they should be or not is a philosophical question the district needs to answer in a uniform way.

METHODOLOGY DETAIL

The information reported in this study is based on the following observations:

A. Visits to 35 mathematics classrooms in 12 Fresno schools.

1. The grade level of the classes visited is as follows:

Pre First	1	Seventh	10
First	5	Eighth	6
Second	8	Ninth	12
Third	6	Tenth	7
Fourth	3	Eleventh	5
Fifth	9	Twelfth	5
Sixth	8		

2. The 12 schools visited include 5 elementary, 4 junior high, and 3 high schools. The schools are listed below:

Thomas	Irwin	Hoover
Carver	Ahwahnee	Edison
Lowell	Sierra	Roosevelt
Gibson	Cooper	
Jackson		

B. Information derived from interviews and meetings with the following persons and groups:

1. Principals in ten of the schools visited

2. Mr. Al Boutte, California State Department of Employment

3. Mr. Dave McClellan, Instructional Materials Center

4. Mrs. Ruth Shonkwiler

5. Mr. Robert Pengilly

6. Chairmen of the Mathematics Curriculum Committees

7. Mr. Reid Gronis, Fresno District Office

8. Miss Margaret Thomas, Guidance Department

9. Mathematics Steering Committee

10. Mr. Jiminez, Fresno Human Relations Office

11. Project Design staff

12. Project Design Advisory Committee

13. Approximately 20 other mathematics teachers whose classes I did not observe

C. Other sources

1. Other informal observations during the time spent in Fresno

2. Reading information furnished by Project Design staff

3. Other knowledge about Fresno gained during 5 years of working with the California Mathematics Council.

The following list includes some of the limitations in the assessment that must be considered in evaluating the results.

A. There certainly were many good teachers in Fresno I did not visit. The sampling was excellent, however, because of the efforts of the Project Design staff. Few fourth grades or geometry classes were visited, but other grades were well represented. While the sample included many types of schools, it is important to realize that it was biased in that many of the schools in Fresno are middle income, with a low percentage of minority students, while I saw only a few of these "typical" schools.

B. I could only visit some schools in the afternoons, and not all mathematics classes met then. This accounts in part for the small number of geometry classes and fourth grade classes visited.

C. The fact that I stayed only about fifteen minutes in each classroom was important, but seemed necessary to provide a larger sampling of classrooms in a limited time.

D. The fact that the observations were made in the spring means that some topics only taught earlier in the year were not reported.

E. The conclusions drawn from the observations are my own opinions. They are supported by what I have seen, additional things I have guessed, and my experiences elsewhere. In a few cases, the findings may be in error. On the other hand, I do feel the results in this report are meaningful, and do actually present a reliable picture of mathematics instruction in Fresno. The fact is accepted that the report contains generalizations for which there are exceptions.

EXPRESSION OF APPRECIATION

I would personally like to express my appreciation to each teacher who let me visit his or her classroom, to each principal and/or mathematics department head who helped with the scheduling and furnished information, and to all the other persons who contributed information to this study. I found complete cooperation in every school and in every classroom. Everywhere, I found concerned teachers who were anxious to help. Many knew little about the study, but they were willing to provide frank answers to my questions when they found that it might help to improve mathematics instruction.

As author of this particular report, I give permission to the Project Design staff, and to other personnel of the Fresno Unified School District, to reproduce all or parts of it for distribution within the district.

SOME SUGGESTED SOLUTIONS

This section is, in a sense, a supplement to the report. Here is a list of suggestions for the Fresno Unified District to consider to help improve mathematics education in the district during the next five to ten years. The suggestions in this section are general, and summarize broad needs often involving many of the strands. In addition to the general suggestions, this report also implies hundreds of specific suggestions, since each specific need listed in the classification matrix can be reworded as a suggestion to meet that indicated need. It should be pointed out once more that this list of suggested solutions does not represent a criticism of present policies, but rather suggests future improvements.

1. Attempt to train at least one resource person so that he will be available in each elementary school, and so that he will thoroughly understand both the content and the teaching philosophy of modern mathematics. He should also be very familiar with current literature in mathematics education and capable of stimulating experimentation in the field.

2. For the terminal student, reduce the number of goals for the mathematics classes, and concentrate on really attaining just a few goals at a time.

3. Try to decide in a realistic way how the television sets now installed can be used to help meet the needs listed in this report. For example, they might show real applications of mathematics or they might be used to teach some strand such as logic that does not appear in present texts. Try to find good times during the day for them to be used, but allow plenty of time for the regular mathematics lesson.

4. Consider extending the mathematics curriculum committees and the steering committees downward to elementary levels and upward to the colleges. This would aid in coordination and would increase the contact between teachers at various levels. Now, the most serious break is probably between grades 6 and 7.

5. Decide which statistics on mathematics education need to be maintained in the district, then set up a plan to keep them available and up to date. The important statistics are those that would help evaluate progress.

6. Attempt to simplify the textbook adoption procedure so that committees of teachers can handle the entire procedure in a few months.

7. Attempt to encourage more professionalism among teachers, including greater attendance at professional meetings, greater emphasis on membership in NCTM and CMC, greater emphasis on professional

reading, and distribution of information on various current experimental programs. The teacher who is truly a professional will often plan to attend professional meetings at his own expense, because he considers this as one of his obligations. Perhaps it would be reasonable for the district to pay the expenses for one professional meeting to match each professional meeting for which the teacher attends at his own expense.

8. Teachers of slow classes, especially those containing minority children, should be very careful in discussing the ability of the children, or their lack of skill, so that the children can hear. It is possible that a feeling of constant failure can become a habit even in the primary years. Note that discussing progress with children, even if they are many years behind, is quite a different matter.

9. Attempt to instill the idea that the teacher himself, as a professional, is actually responsible for his own inservice education. The district merely provides the setting and whatever help is needed. For example, every elementary teacher should begin to think about the course of action she will pursue to be able to use the new state adoptions. She will request help from the district, through organized inservice activities, when she feels that this is necessary.

10. Music lessons and other reasons such as this should never take children out of mathematics classes. Both subjects are important, and there should be separate times for each.

11. Systems such as the "mod schedules" are primarily administrative devices, and are rarely suggested by subject matter experts. They may or may not have a good influence on the program of instruction. They should be evaluated to see if there is any evidence that they contribute to more learning in mathematics. If their effect cannot be measured, then they should be evaluated in more general terms. In other words, there is little evidence from across the nation that different scheduling arrangements really make much difference in improving mathematics instruction.

12. There is some experimental evidence to show that afternoon is not the best time to teach mathematics. Consider some experimentation to find the best time of day, then move as many classes as possible to that time. This problem may be connected to the problem of lack of air conditioning in many classrooms.

13. There is plenty of material for the production of several M. A. theses involving the needs of the district in mathematics education. The writing of these theses might lead to further attempts at improvement.

14. The open enrollment policy seems more good than bad, and should be continued until some other policy is shown to be superior.

15. In some elementary schools, and with some teachers, it is possible that an hour lesson on mathematics is too long. In these cases, it might be better to split the lesson into two parts, so that the children would not get tired of the material.

16. Consider the establishment of a tutoring program in Fresno so that qualified high school and college students might volunteer to help slow or culturally deprived children raise skill levels. Possibly this suggestion might be related to summer school opportunities.

17. Consider having the approximately 160 secondary mathematics teachers meet together at times and work together more closely as a team. They should be able to decide some policies and to make suggestions for experimentation. This would also help to coordinate efforts and to spread information. But do not have meetings just for the sake of meetings. Probably this sort of meeting would be a part of the fall orientation program.

18. Fresno has pre teachers who are high school students. It also has some student teachers in the classrooms, but these are really graduate students in most cases. Consider some plan to get more college students at other levels into the classroom.

19. For large group instruction, provide a self-contained, roving microphone so that the teacher will be able to move around more freely.

20. Attempt to hire some experienced mathematics teachers in the district who have been teaching in districts in other parts of California where there has been more experimentation. Also attempt to hire more new teachers from other teacher training colleges in California. The present hiring policies seem destined to maintain the existing program, but will not produce significant changes. Emphasize with potential new teachers that five years from now, Fresno will be an even more desirable place to live, while the more crowded parts of the state will be less desirable. Also emphasize the availability of reasonable housing relatively near the schools, a situation that does not exist in many districts in the state.

21. Consider a plan to train teachers before they begin teaching in minority classes. Probably new teachers should always teach elsewhere first, but should observe minority classes for a long period of time, then work with an experienced teacher. The training is more a matter of psychology than of mathematics content. There are arguments on both sides, but I believe that the personality and specific training of the teacher for minority children is more important than his race or cultural background.

22. Study the problem of what diagnostic and achievement tests are really needed so that each teacher can see how each child is actually progressing from year to year in mathematics. Then provide these tests and see that the results are made available and used. Recognize that how to take a test is a skill that must be taught, especially to some culturally deprived students.

23. Attempt to bring computers into the mathematics curriculum, instead of having them remain a frill.

24. It is almost too late to begin preparing teachers of grades 1-8 for the new texts, but much should be done before the texts are actually chosen, so that they can be used more successfully than the present ones. Recognize that it is quite likely that the actual state texts chosen will not be the ones that would have been selected by Fresno teachers.

25. Experiment to see if reading can be taught partly in mathematics classes in connection with reading the text and attempting to understand word problems. Experiment to see if mathematics can be taught partly in reading classes in the same ways. I can see no excuse for having children in the eighth grade who cannot read. If they cannot read, then they should never be in the eighth grade, because both they and society are being deceived.

26. Give teachers live examples in various forms of pupils actually taking an active part in mathematics, rather than just sitting. Investigate possibilities for using a laboratory approach part of the time, but remember that firm control is essential.

27. Collect good applied problems from various teachers and make them available to all teachers at that level.

28. Assume that much of the responsibility for guidance in mathematics must rest with the mathematics teacher, because of the shortage of other staff.

29. Attempt to stimulate the use of audio visual materials for some of the purposes suggested in this report. Study carefully the frequency of use of various mathematics materials in the central office, such as filmstrips and transparencies.

30. Keep informed on future requirements in state testing, because great changes are being made in the tests required.

31. Attempt to distribute news about some of the good ideas that individual teachers in the district are using. Encourage the teachers to share this information, and think of means for them to do it.

32. Think through this problem very carefully. As a high school becomes one with more and more minority students, there is less and less emphasis on academic mathematics, and more mathematics for terminal students. This may well lead to great disappointment in the long run, once minority groups really understand what is happening. Before anyone concludes that all students should be prepared for college, however, he should visit some general mathematics classrooms and compare the students with those in algebra classes. Often, even the physical appearance of the students is very revealing, and attitudes are much different. There is a complaint that guidance is inadequate, but individual students must realize that they often make a negative impression on adults quickly because of their long hair or bad hair styles, their poor choice of clothes and shoes, and their conduct. How can an adult feel that such students have the potential to be leaders?

33. Consider the establishment of a set of minimum requirements in mathematics for all children at each grade level. Many teachers now feel frustrated because they think children are progressing slowly, but they do not know how slowly. Many children seem frustrated because they have the same thing over and over again without seeming to make any progress. For some high school graduates, they and society are deceived because they have less than eighth grade competence in some subjects, yet have a high school diploma. The district should consider very carefully whether such a policy actually does more harm than requiring certain skills before a student is permitted to go on to certain grade levels.

34. Encourage teachers to study some more mathematics, but encourage them even more to really understand the philosophy of teaching modern mathematics. They need to hear explanations of the study of mathematics in modern terms, and need to try to stimulate student discovery and intuition.

35. Consider how to begin to teach several strands that appear in the Strands Report but are absent, or virtually absent, from Fresno schools.

36. Aim for a curriculum that includes modern topics, but that does not neglect any basic skills. Strive for a balance in teaching both skills and concepts in a limited time.

37. Recognize that schools vary greatly within the district, and that policies applicable to some may not be applicable to all. In mathematics education, it is probably better to strive for somewhat more uniformity than now exists, but this should be done over a long period of time.

TF12 - MATH

MAJOR CONCLUSIONS IDENTIFIED BY PROJECT STAFF

TF12- 1. The present content of the mathematics program should incorporate the concepts described in the Revised Strands Report, October 1967. These strands should be included in such a way that they cross grade levels and be in harmony with the current grade level activities.

TF12- 2. The need exists for a greater understanding and the use of modern teaching methods in connection with modern mathematics. Particularly there should be an increase in laboratory type activities and student related problems.

TF12- 3. Adequate drill is an essential in modern math.

TF12- 4. Teachers of minority groups need additional training and information before beginning to teach modern mathematics.

TF12- 5. A careful analysis of mathematics for terminal students is needed with a concern for reducing the number of goals and attaining few goals at a time.

TF12- 6. There is a need for a district wide program of diagnostic and standardized tests that is related to the state math testing program with the results of the tests available to teachers and students.

TF12- 7. Explore the use of small calculator-computers as an integral part of the total mathematics program.

TF12- 8. Recruiting and in-service training should provide teachers who understand both the content and philosophy of modern mathematics.

TF12- 9. Preparation for state math text adoptions at the elementary level should be made prior to the time the books are out into use and the district adoption procedures at the secondary level should be simplified.

TF12- 10. Explore more carefully the relationship between the reading and the mathematics program.

TF12- 11. Pupils need more guidance, especially prior to the ninth grade, on the relationship of employment prospects and the mathematics needed to qualify for various jobs.

TF12- 12. There needs to be more involvement of the parents and the community in the responsibility for the mathematics program, particularly to give the student out of class opportunities to perfect the skills being developed.

TF12- 13. Higher mathematics courses need to be evaluated very carefully in terms of their purposes as related to college entrance.

TF12- 14. Mathematics steering and curriculum committees should include representatives of all levels of instruction elementary through college.

TF12- 15. The district should encourage professionalism among teachers, including membership in associations, attendance at professional meetings, professional reading, and data distribution concerning the current program and significant activities of local teachers in the area of mathematics.

TF12- 16. There is a need for an expression of the over-all philosophy of mathematics education in the Fresno City Schools.

PROJECT DESIGN

NEEDS ASSESSMENT PUBLICATIONS

1. Brainstorm - Needs Perceived by School Staff
2. Speak-Up - Needs Perceived by Community
3. Student Speak-Up - Needs Perceived by Secondary Students
4. School Staffing
5. Analysis of Achievement
6. Problems Perceived by Educational Leadership

County Schools Survey

7. Vocational Occupational Needs Survey (published by County Regional Planning and Evaluation Center - EDICT)
8. Other County School Needs Survey Reports (by EDICT)
9. Other County School Needs Survey Reports (by EDICT)

TASK FORCE

Educational Content Fields

10. Reading
11. Language
12. Mathematics
13. Science
14. Foreign Language
15. Cultural Arts
16. Social Science
17. Physical Education

Other Educational Areas

18. Teaching/Learning Process
19. Special Education
20. Guidance
21. Health
22. Student Personnel
23. Adult Education
24. Vocational Education

Urban Physical Factors

25. Urban Physical Factors

Urban Social and Human Factors

26. Relevance and Quality of Education for Minorities
27. Special Needs of Mexican-Americans
28. Special Needs of Negroes

29. Conclusions from Needs Assessment Publications
30. Summary - Fresno Educational Needs Assessment
31. The Process of Educational Planning